The Potential for Large Scale Carbon Sequestration and Landscape and Biodiversity Rehabilitation in Australia

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Representing
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Introduction

The Kyoto Protocol potentially poses significant threats to Australia's resource industries but it also provides a major opportunity to address many long term, intractable environmental problems resulting from the extensive clearing of native vegetation in Australia.

The magnitude of the increase in carbon dioxide emissions into the atmosphere means that no single activity will be sufficient to cause a significant reduction in growth of emissions. It is estimated that approximately 7 billion tonnes of carbon dioxide is released into the atmosphere and approximately 3 billion tonnes accumulates in the atmosphere resulting in the progressive increase in carbon dioxide concentrations. A significant proportion of the increase in emissions is derived from native vegetation clearing, particularly in Australia. It follows, therefore, that cessation of clearing and revegetation can make a significant contribution to reducing greenhouse gas emissions.

Carbon sequestration, even though it is provided for in Article 2 of the Kyoto Protocol, has been rejected by some groups as an effective greenhouse mitigation strategy for a variety of reasons including the lack of arable land, the permanence of carbon sinks and the perception that the quantity of carbon sequestration that could be sequestered would be insignificant.

The objective of this paper is to demonstrate that a number of the concerns about the role of carbon sequestration can be addressed by description of a program currently being implemented in Western Australia. The program is utilising a unique tree species - Mallee Eucalypts established on cleared productive agricultural land for the purpose of carbon sequestration, land and biodiversity rehabilitation and regional economic development.

A. The Need for the Reestablishment of Trees on Agricultural Land

It is difficult to exaggerate the magnitude of the environmental consequences of the extensive land clearing that has taken place in Australia over the past 200 years. Currently more than 2.4 million hectares of land are affected by salination and it is projected that this area will grow to in excess of 15 million hectares if no remedial action is taken.

Table 1
Land area affected by salinity

State	Current (hectares)	At equilibrium (hectares)
WA	1,804,000	6,109,000
NSW	120,000	7,500,000
VIC	120,000	1,200,000
SA	402,000	600,000
QLD	10,000	74,000
Other	Minor	Unknown
Total	**2,476,000**	**>15,483,000**

In addition to the loss of agricultural land, unique conservation assets have been destroyed, there is already significant damage to infrastructure caused by rising saline water tables and evidence that flood frequencies and size will increase as the lower landscapes become saturated.

In Western Australia where the salinity problem is more advanced and more detailed data is available it is estimated that within three to four decades an average of one third of every farm will be affected by salination and more than 400 species will become extinct (State Salinity Council (2000)).

In the Murray Darling Basin it is estimated that between 3 and 5 million hectares of land in the eastern and southern regions of the Basin will be salt affected within 50-100 years and rises in average salinity in many key tributary systems will endanger their use for irrigation and urban purposes (Murray Darling Commission –Draft Salinity Strategy (2000)).

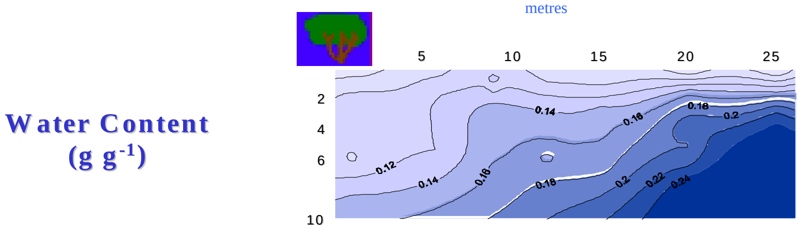
Figure 1 Lake Taliban. Freshwater lake destroyed by salinity

Figure 2 Lake Toolibin. One of only three freshwater wetland systems remaining in the Western Australian Wheat Belt

B. Cause of Salination.

The principal cause of dryland salination is the replacement of perennial vegetation with annual crops which only use a proportion of the annual rainfall resulting in excess recharge of saline groundwater tables which over time rise to the surface.

Re-establishment of the original water consumption levels by planting perennial crops is only one of a number of strategies that will be required to restore the hydrological equilibrium. But the fundamental cause of salination will only be addressed by the establishment of perennial vegetation at a density that at least partially restores preclearing groundwater recharge levels. The … to annual rainfall and … pe will need to be reve…



Data from Robinson et al (2002) for mallee on Wickepin deep clay loam

Figure 3 Water Depletion by mallee trees at varying distances from 'alleys'

The configuration of planting is as important as the area planted. Research trials have demonstrated that it is possible to achieve significant reductions in groundwater recharge by planting trees in an 'alley' or 'hedge' formation (Figure 3, see frontispiece). This configuration allows for the integration of tree crops into the farm management plan, maximises the growth of the trees and the uptake of surplus water.

C. Mallee Eucalypts.

Mallee eucalypts are endemic to Australia and are characterized by multiple wood stems arising from an underground lignotuber (Kerr, 1925; James, 1984). More than 200 species of Mallee Eucalypts are endemic to Western Australia but Mallees occur naturally across broad regions of southern Australia. They were cleared extensively for agricultural production and their natural distribution significantly overlaps the major southern agricultural regions of Australia.

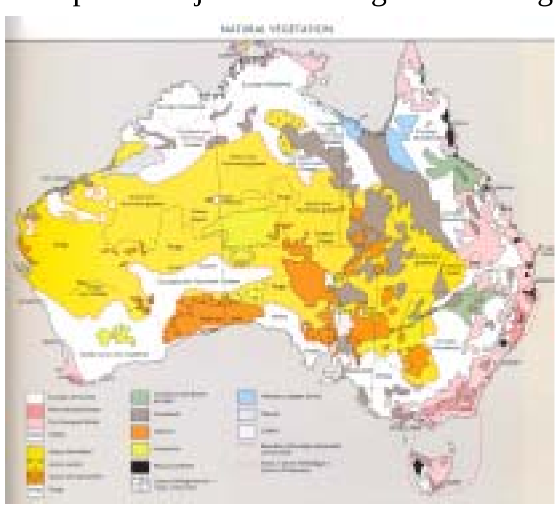


Figure 4 Natural Distribution of Mallee Eucalypts

Mallee Eucalypts occur in rainfall zones between 250-450 mm and have unique characteristics which make them ideal “carbon sinks”-

- They occur naturally over an extensive area including the low rainfall agricultural regions where land prices are significantly lower than areas where other tree species are planted.
- They are fire resistant and able to grow in infertile soils and survive extended periods of drought and high temperatures.
- They have a large lignotuber or ‘underground stem’ which in addition to providing an underground carbon sink also provide a source of latent buds which regenerate rapidly if the above ground stem is destroyed or harvested.
- They are long lived. It is estimated that some mallees will grow in excess of 6,000 years (Rosetto et al, 1999). In areas where natural mallee species have been utilised for over 100 years for the production of eucalyptus, oil native mallee has survived for over 100 years on a 2-3 year harvesting cycle.
- The species is able to achieve high productivity when grown in an ‘alley’ configuration. For example Mean Annual Increments at eight years of E. plenissima have been recorded at 29 tonnes of carbon dioxide per year. (See Figures 5a, 5b and 5c.)
- After the initial establishment period they can be harvested on a 3-5 year cycle and have the potential to produce a number of products including biomass for renewable energy production.

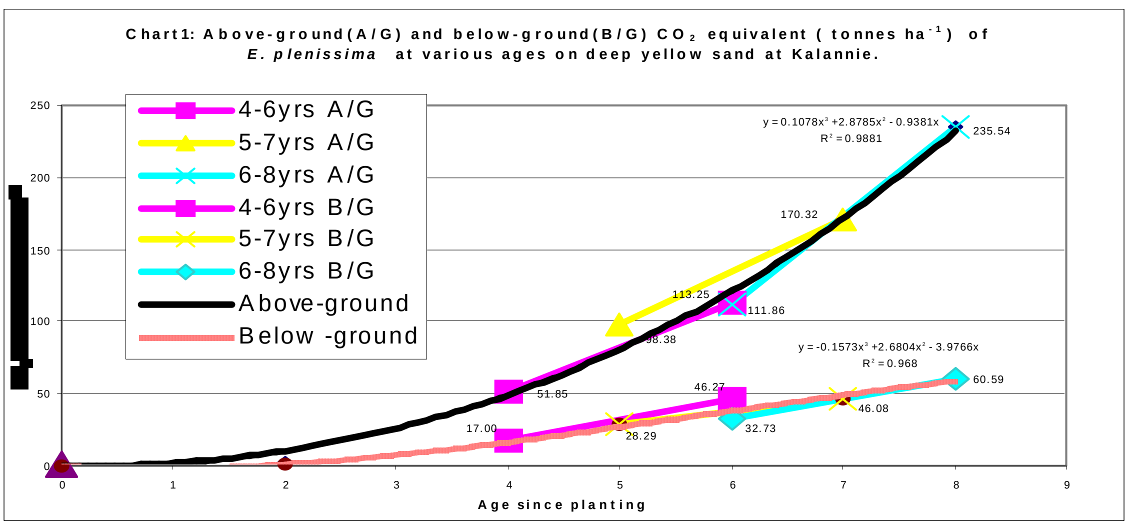


Figure 5a Above ground (A/G) and below ground (B/G) Carbon Dioxide equivalent (tonnes/ha.) (Department of Conservation and Land Management and Oil Mallee Company of Australia – unpublished data)

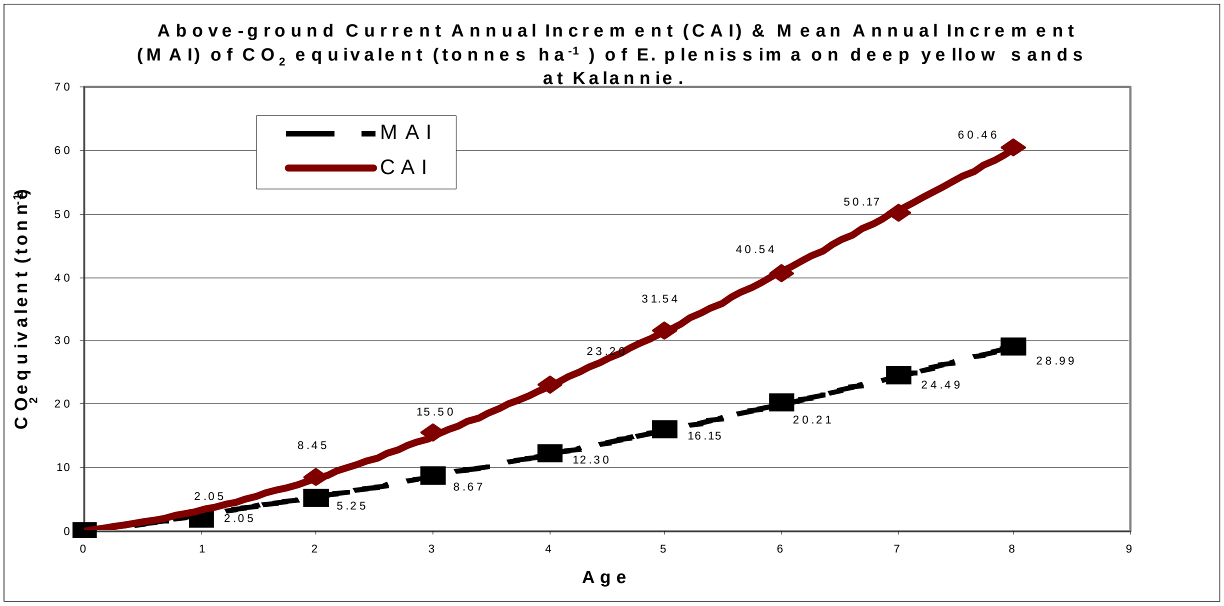


Figure 5b Above ground Current and Mean Annual Increments for E. plenissima (Department of Conservation and Land Management and Oil Mallee Company of Australia – unpublished data)

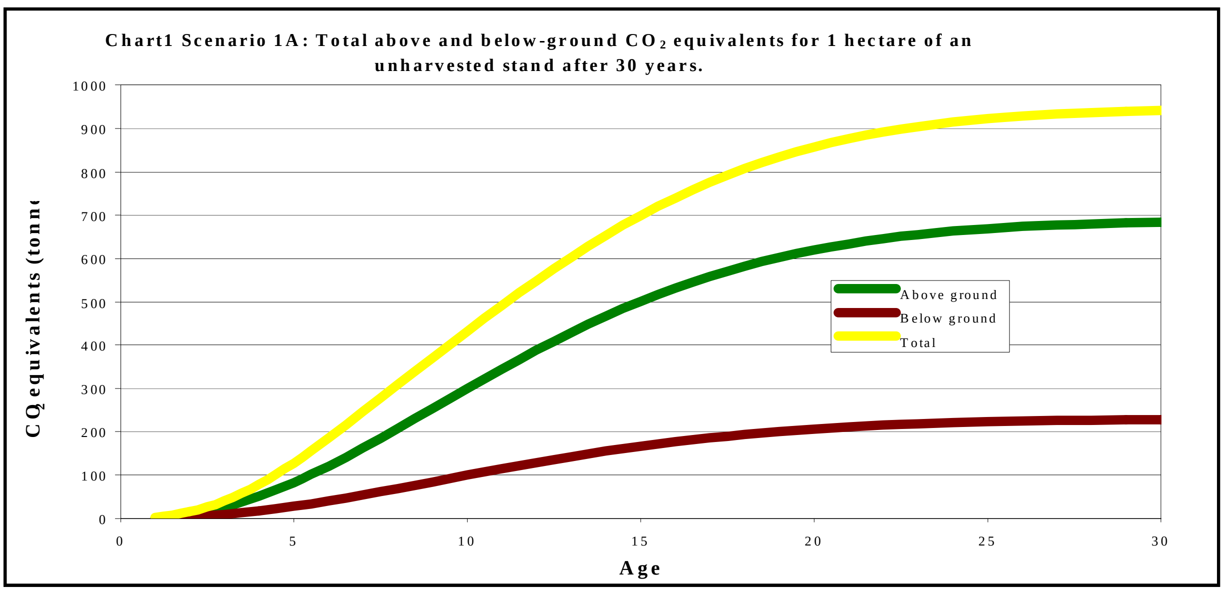


Figure 5c Estimated carbon sequestration capacity (unharvested) of E. plenissima over 30 year period (Department of Conservation and Land Management and Oil Mallee Company of Australia – unpublished data)

Figure 6 Natural Mallee

Figure 7a Root system of 3 yr old planted E. plenissima.

Figure 7b Root system of mature native E. plenissima

D. Area of Land Available.

In Western Australia it is estimated that of the 18 million hectares of cleared land it will be necessary to plant between 10% and 30% with perennial crops to stabilise the rate of increase in salination.

Table 2

Land Use	Area (million ha)	% of area within the agricultural region
Agricultural region (>250mm rainfall)	25.25	100.0
Private land	20.73	82.0
Private land under agriculture	17.98	71.2
Private with original native vegetation	2.75	10.9
Public land (State forest, reserves, parks)	4.52	17.9

This would equate to approximately 3 million hectares. There are no detailed figures on the area of planting required in other States with increasing dryland salinity problems but it is reasonable to assume based on the Western Australian data that the total replanting area required in Australia would approximate 10 million hectares.

Most if not all of this land is privately owned. In Western Australia, agricultural land for the establishment of tree crops has been readily accessed provided that the price paid for leasing the land was at least equal to the returns to farmers from their agricultural production and that tree crops were integrated into the farm management plan.

E. Legal Security

Western Australia has established "Carbon Rights" legislation and a Tree Plantation Agreement Act which ensures the ownership of the trees and the carbon they sequester while the landowner retains the title to the land and provides a framework for agreements between farmers (landowners) and investors in tree plantations which provides security for both parties.

F. The potential contribution that Carbon Sequestration can make relative to the potential demand for Carbon Dioxide Offsets in Australia.

Australia's greenhouse gas emissions in 2001 were estimated at 543 million tonnes and are projected to increase to 684 million tonnes in 2020. (Australian Greenhouse Office-National Greenhouse Inventory).

Based on the assumption that 3 million hectares of Mallee Eucalypts can be planted in an 'alley' configuration on Western Australian wheatbelt farms and that the mean annual increment of carbon dioxide tonnes is 30 the annual rate of sequestration would be 90 million tonnes. Thus over a thirty year period a carbon sink of 2.7 billion tonnes would be created.

If it was possible to produce long lived carbon products from the above ground stems of Mallee on a 3-5 year harvesting cycle it would be possible to maintain the trees in the most vigorous phase of their development for over 100 years. This would significantly increase the rate of carbon sequestration and the maximum amount of carbon that could be stored per hectare

For example Western Power (the Western Australian owned Power Generation Authority) is in the final stages of completing a pilot Integrated Processing Facility which will use Mallee Eucalypt feed stock to produce activated carbon, eucalyptus oil and electricity.

G. Progress of Plantings

25 million mallee trees have been planted over the period from 1994 - 2003 in the Western Australian wheat belt (Bartle and Shea, 2002).

The first major contract plantings were undertaken on behalf of the Kansai Electric Power Corporation of Japan in 2003. The Oil Mallee Company of Australia Ltd established 1,000 hectares (2.5 million trees) on 24 farming properties. Kansai funded all establishment and management costs and will pay a lease fee for the area planted to each of the farm owners.

Figure 8 Aerial view of 'alleys' of Mallee Eucalypts established for Kansai.

Figure 9 Nine week old mallee seedlings planted in an 'alley' within a wheat crop.

H. Cost per tonne of Carbon Dioxide sequestered.

The cost of sequestration varies according to soil productivity and the discount chosen to calculate present costs. Precise information on costs is subject to confidentiality agreements but the cost of sequestration per tonne of carbon dioxide using Mallee Eucalypts is significantly below current US$15 assuming a discount rate of 7%.

I. Conclusion.

There is a large land base in Australia available for the establishment of Mallee Eucalypts provided that they are integrated into farm plans in a 'alley' or 'hedge' configuration. In addition to creating a large long term carbon sink, extensive Mallee Eucalypt plantings could make a major contribution to rehabilitation of land degradation, preventing infrastructure destruction, restoring biodiversity and provide significant employment in regional communities.

J. References.

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